Bi-Monthly Progress Report

E7.3 10670.

CR-132181

Reporting Period: 1 March to 30 April 1973

A. Title of Investigation:

Evaluation and Comparison of ERTS Measurements of Major
Crops and Soil Associations for Selected Sites in the
Central United States

ERTS-A Proposal Number: SR 050

B. GSFC Number UN630
Principal Investigator: M. F. Baumgardner

C. Problems.

There have been no major problems. CCT's have been arriving
regularly. One minor problem which continues to plague us is
the unpredictible quality of the MSS digital data. Occassionally
one band of data will be bad, and this greatly reduces the
utility of the data.

Although the investigator has received dozens of frames of
data for the Lubbock Regional Test Site, very little data have
been received for the test sites of Wells County, North Dakota;
Humboldt, Iowa; McPherson County, Nebraska; and Greeley County,
Kansas.

D. Progress during this two month reporting period is described
below:

1. Soils Studies. This study has been confined to the data
from the Lubbock Regional Test Site. With ERTS MSS data for the
passes on 9 October, 14 November, and 2 December soils patterns
and boundaries have been delineated and mapped for Lynn County,
Lubbock County, and Crosby County, Texas.

Work is progressing on an evaluation of bands 5 and 7 for
soil mapping purposes.

2. Vegetation Studies. Computer tapes from July (1006-
16522 and 1007-16575) and August (1024-16522 and 1025-16580)
ERTS passes over several test sites were received and reformatted
for analysis with the LARSYS software system. Analysis was
begun for data obtained in August over the Lubbock (Texas)
Regional Test Site. These data will be overlayed with ERTS data

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(already analyzed at LARS) from passes in October and November. Comparisons between ERTS data from different dates will be studied for purposes of crop identification. The August data have been very useful in locating ground observation site for use in supervised classification of crops and other vegetative cover types. These studies have been confined to the counties of Lynn, Lubbock and Hale.

3. Land Use Inventory.

Analysis of ERTS data from the Lubbock Regional Test Site is continuing. Initial temporal overlay studies have been conducted with ERTS data from passes in August, October and November for Crosby and Lubbock counties. Emphasis has been placed on the identification and mapping of different land use classes, including cultivated lands, urban and built up areas, transportation corridors, improved pasture lands, wildlands, lakes, reservoirs and rivers. (Scene I.D.'s 1024-16522, 1078-16524, 1114-16532).

Non-supervised classification of the city of Lubbock was accomplished using three different scales (Scene I.D. 1078-16524).

CCT's (Scene I.D. 1021-16333) covering the Kansas City area were received, reformatted, and analyzed. A detailed analysis was made of the Kansas City metropolitan area. A false color image (ERTS MSS bands 4, 5, 7) was produced of the Kansas City area at an approximate scale of 1:590,000. A 12-cluster spectral map (nonsupervised classification) of the same area at the same scale was produced. This served as a base map from which a training set was selected for a supervised classification of eight spectral classes. In general these classes corresponded to river water, reservoir water, commercial, older (denser) residential, open areas (parks, golf course, cemeteries) and agricultural classes.

4. Arid Lands Studies.

Several ERTS frames (Scene I.D.'s 1133-16591, 1133-16593, 1133-17000, 1134-17052, 1153-17105) have been received, reformatted, and analyzed in the preparation of an invitational paper on "Arid Lands and Remote Sensing" for the Congress on Science and Man in the Americas, cosponsored by the American Association for the Advancement of Science and the Consejo Nacional de Ciencia y Tecnologia of Mexico. The area of study for this paper is the Texas-Pecos region in West Texas and Southeastern New Mexico. Vegetative cover types; location, extent and methods of irrigation; areas of active wind resources; and amount of surface water are among the areas under investigation. Geologic features such as folds and faults and an inventory of land forms are also being mapped from ERTS MSS data.

5. Water Resources.

Lynn County, Texas was selected as an area to examine the surface water resources. Three ERTS frames (Scene I.D.'s 1078-16524, 1114-16532, and 1132-16532 for 9 October, 14 November, and 2 December were analyzed. Since water has very low reflectance in the near infrared wavelengths (ERTS spectral bands 6 and 7), it was easy to separate and map playas and reservoirs containing water. Water was separated spectrally from all other categories for three ERTS overpass dates. It was found that many of the playas containing water on 9 October contained no water on 14 November; many with no water on 14 November had water on 2 December.

Examination of the precipitation records revealed a record high rainfall for August and September. At the time of the 9 October ERTS overpass essentially all playas were full. During the three weeks prior to the 14 November overpass very little rain had fallen in Lynn County. Water in the playas had been partially or completely depleted by evaporation and/or seepage to groundwater recharge. The period from 12 November to 2 December was characterized by cloudy days, high humidity and several light rains. The ERTS data for 2 December reveals water in many playas which had no water in mid-November.

The following table provides an estimate of the water surface area for the three dates:

Date	Points	Hectares
9 Oct.	4374	1924
14 Nov.	3735	1643
2 Dec.	5120	2253

Total area - 197683 hectares.

E. Significant Results:

Perhaps the most significant result was the use of the temporal overlay technique where the computer was used to overlay ERTS data from three different dates (9 Oct., 14 Nov., 2 Dec.). The registration of MSS digital data from different dates was estimated to be accurate within one half resolution element. The temporal overlay capability provides a significant advance in machine-processing of MSS data. It is no longer essential to go through the tedious exercise of locating ground observation sites on the digital data from each ERTS overpass. Once the address of a ground observation site has been located

on the digital data from each ERTS overpass. Once the address
of a ground observation site has been located on a digital tape
from any ERTS overpass, the overlay technique can be used to
locate the same address on a digital tape of MSS data from
any other ERTS pass over the same area.

The temporal overlay technique also adds a valuable
dimension for identifying and mapping changes in vegetation,
water, and other dynamic surface features.

F.   Publications, papers, abstracts of talks:

1.   Baumgardner, M. F., S. J. Kristof, and J. A. Henderson, Jr.
     Identification and Mapping of Soils, Vegetation, and
     Water Resources by Computer Analysis of ERTS MSS Data.
     Presented at the ERTS-1 Symposium on Significant Results.

2.   Baumgardner, M. F. Use of ERTS-1 in Agriculture,
     Forestry, and Other Vegetation Surveys. Presentation
     at the 54th Annual Meeting of the American Geophysical
     Union; Washington, D.C., 16-20 April 1973.

G.   Recommendations: None

H.   No further additions or changes are contemplated for the
     ERTS standing orders.

CCT's representing 76 scenes have been returned to NDPF.
These tapes were of limited use in this project because the
data (1) did not fall sufficiently within a test site, or
(2) the sites had excessive cloud cover. The Scene I.D.'s
for the returned CCT's are as follows:

1080-17014	1130-16390	1168-16533
1051-15591	1134-17022	1149-16482
1094-16420	1134-17031	1168-16535
1043-16575	1130-16422	1166-16420
1080-17000	1151-16563	1168-16524
1095-16472	1149-16480	1168-16530
1095-16465	1148-16422	1150-16541
1096-16524	1167-16481	1169-16573
1095-16481	1178-16045	1186-16524
1095-16474	1167-16477	1186-16533
1094-16422	1167-16747	1170-17043
1043-16582	1152-17030	1188-17041
1096-16533	1167-16465	1203-16483
1097-16591	1152-17003	1203-16474

1096-16535	1170-17045	1203-16481
1097-16585	1166-16423	1206-17005
1097-16594	1169-16582	1206-17023
1105-15593	1169-16584	1206-17050
1113-16464	1169-16593	1205-16585
1114-16541	1134-17022	1205-17000
1116-17031	1169-16570	
1115-16593	1169-16591	
1116-17033	1150-16534	
1115-16590	1170-17040	
1115-15584	1186-16540	
1123-15594	1186-16531	
1123-16000	1187-16544	
1133-16584	1185-16475	

I. ERTS Image Descriptor Forms:

Appropriate ERTS Image Descriptor Forms are included as Attachment 1, to this report.

J. Data Request Forms:

No ERTS Data Request Forms were submitted to GSFC/NDPF during this reporting period.

K. Aircraft Underflight Information:

Color and color infrared imagery was taken on 20 March 1973 of part of the Lubbock Regional Test Site (Mission 230). The color infrared imagery is of rather poor quality while the color imagery is very high quality data.

ERTS IMAGE DESCRIPTOR FORM
(See Instructions on Back)

DATE __May 1, 1973__

PRINCIPAL INVESTIGATOR __M. F. Baumgardner__

GSFC __UN630__

ORGANIZATION _____

NDPF USE ONLY

D _____
N _____
ID _____

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* Sand dunes		River	DESCRIPTORS
1134-17052 MD	x			Playa
1133-16593 MD	x		x	Oil field Irrigation
1133-17000 MD			x	Anticlines Dome Lava flows
1132-16541 MD			x	Anticlines Dendritic drainage
1133-16591 MD				Rangeland Circular irrigation
1153-17105 MD			x	City Air field
1024-16522 MD				Agriculture Playas Urban
1025-16580 MD				Agriculture Irrigated Areas

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

MAIL TO   ERTS USER SERVICES
CODE 563
BLDG 23 ROOM E413
NASA GSFC
GREENBELT, MD. 20771
301-982-5406

GSFC 37-2 (7/72)

ABSTRACT

IDENTIFICATION AND MAPPING OF SOILS,
VEGETATION, AND WATER RESOURCES BY
COMPUTER ANALYSIS OF ERTS MSS DATA*

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A test site covering an area of 31,000 Km.^{2} was selected in
West Texas to assess the utility of ERTS MSS digital data for
mapping and monitoring the soil, vegetation, and water resources
of the region. The ten county area, known as the Lubbock
Regional Test Site, encompasses a variety of geologic, topographic,
soils, agricultural and rangeland features.

Usable MSS data from portions of the test site have been
analyzed from four different ERTS cycles. Using computer-
implemented overlay techniques, ERTS MSS data obtained on three
different dates over Lynn County, Texas have been analyzed. Temporal
changes in vegetation and water supply in the playas were identified
and mapped.

Six cooperating ground observers in each of the ten counties
are obtaining pertinent soils and crop data at the time of each
ERTS pass. Each observer records and reports data from each field
along a 6-10 kilometer county road segment. These sixty ground
observation segments are well distributed throughout the 10 counties.

Training sets for computer-implemented analysis of ERTS data
are extracted from the ground observation data. Training sets from
one county are used to classify ERTS data from other counties.

Surface features which have been easily identified include row
crops, unimproved rangelands, improved rangelands, bare soils,
winter wheat, playas, rivers and streams, towns and cities, reservoirs,
and gross geologic and soils features.

Preliminary results suggest that with these techniques,
scientists should be able to identify drought conditions, crops
damaged by hailstorms, areas of active wind erosion, and crop
species. Each of these factors should contribute to better yield
predictions and more efficient management of agricultural resources.

The LARSYS software system is a package of computer programs, which have been designed to analyze and display remotely sensed multispectral data. Five major processing algorithms were used in this study: (1) CLUSTER, (2) STATISTICS, (3) CLASSIFYPOINTS, (4) PRINTRESULTS, and (5) NEWPHOTO. The CLUSTER processor is an unsupervised classifier that groups data vectors into spectrally distinct classes. Mean vectors and covariance matrices are calculated by the STATISTICS processor and are then used in the CLASSIFYPOINTS processor which performs a maximum likelihood Gaussian classification on a point-by-point basis over the entire area. Results from the above analysis are displayed using: (1) the PRINTRESULTS processor to make alphanumeric maps; and (2) the NEWPHOTO processor to display the results on the digital display.

The Digital Image Display System receives an image from a System/360 computer, stores this data in a video buffer, and displays the image in a raster scanning mode on a standard television screen. An interactive capability to edit, annotate, or modify the image is provided through a light pen and a program function keyboard. An additional photographic copying capability is also provided.